proper quality of tone or *feeling* to the whole sound of his orchestra, considered as a single instrument, by regulating *the relative intensities* of the sounds produced by the various classes of instruments employed. Now this third function, the regulation of relative intensities, has hitherto been discharged through the judgment of the ears of a conductor who is placed in the most disadvantageous position for judging by his ears. Surely he is not conducting for his own personal gratification, but for the gratification of his audience, whose ears stand in very different relations from his own in respect to their distance from the various instruments in action. Is it not time that he should pay more attention to his third function and place himself in the position occupied by an average hearer? This position would be elevated, and somewhere in the midst of the audience. The exact determination of its place would depend on various conditions which cannot now be considered. That the position at present occupied by the conductor of an orchestra has often allowed him to deprive his audience of some of the most delicate and touching qualities of orchestral and concerted vocal music I have no doubt, and I firmly believe that when he changes his position in the manner now proposed the audience will have some of that enjoyment which he has too long kept to himself. During the past winter, in the Academy of Music at New York, I fully confirmed all the foregoing surmises, by placing myself in different parts of the house to observe the different results, and my opinions were fully shared by others who have a more delicate musical organisation than I can lay claim to.

In large orchestras, these interferences of sonorous sensations are so multiplied and various as to be beyond our mental conception. By taking them up in detail, some general laws may, however, be evolved. But it will be impossible to formulate such laws until, firstly, we are in possession of a *quantitative* analysis of the compound tones of all musical instruments (that is, until we know the relative loudness of the partial tones of which they are composed at all parts of their compass), and secondly, we have determined throughout the musical scale the relative intensities of the sounds (of simple tones) when obliteration of the sensations of higher (simple) tones supervenes. The powerlessness of one sound to affect the sensation due to another sound lower than itself in pitch greatly simplifies this problem.

Quantitative analysis of the compound tones of musical instruments is now the great desideratum of the composer. It is only after we know the relative intensities of the components of typical musical tones used in orchestral performances, that we can so regulate their intensities as to give those qualities of sound which the composer desires to be heard. Thus, it at once becomes evident that the instruments used in orchestral music should be very differently constructed from those used for solos or quartets. In orchestral instruments certain *characteristic* upper partials (overtones, harmonics) should predominate, in order to find expression in the midst of other and graver sounds. Such orchestral instruments will therefore have exaggerated peculiarities in their qualities of tone, which will render them unfit to be played on alone, and uninfluenced by other orchestral notes. It is surely not hopeless to anticipate that empirical rules may be attained, which will guide the musical instrument-maker to the production of those special qualities of tone required in orchestral instruments. It is fortunate that the very phenomena of the interferences of sonorous sensations will assist in the much desired solution of the problem of measuring the intensity of a sound (simple tone), either when existing alone or as component of an ordinary musical (compound) tone. On this subject I am now engaged. It is evident (by way of illustration), that so far as concerns the measure of the relative intensities of sounds *of the same pitch*, this problem has already received the simplest solution by merely placing these sounds at various distances, and obliterating the sensations they excite by means of a constant and standard sound of a lower pitch. But I reserve a description of this work for a more formal publication.

NOTES

PROF. HUXLEY, who has recently left for America, has accepted an invitation from Prof. W. B. Rogers to attend the Buffalo meeting of the Association for the Advancement of Science, and also to deliver a course of lectures before the Johns Hopkins University. His stay, however, in the country will be but short.

THE Academy of Sciences of the Institute of Bologna announces an open competition for the Aldini Medal, to be awarded to the author of the memoir of greatest experimental and scientific value in galvanism. The medal is of gold, of the value of 1,000 liras, and is open to all works which profess to have extended our knowledge in any department of galvanism, and which may be sent to the Academy expressly for the competition, during the two years comprised between June 1, 1876, and May 30, 1878. Memoirs must be written in Italian, Latin, or French. The usual conditions of such competitions are to be observed, and memoirs should be sent in before the last-mentioned date, addressed "Al Segretario perpetuo dell' Accademia delle Scienze dell' Istituto di Bologna."

WE notice in the *Revue Scientifique* further particulars regarding the meeting of the French Association for the Advancement of Science, to be held at Clermont-Ferrand on the 18th inst. A list of the papers to be read is also given. This is a very useful arrangement for those who may anticipate taking part in the proceedings, and others, and might with advantage, we think, be copied in this country. In the group of physics and chemistry we note the following among the subjects to be treated:—Diffraction in optical instruments; new volumetric determinations of arsenic; new salts of bismuth; experiments made to determine if the ether is ponderable; observations in celestial and terrestrial physics in Japan and Siam (by M. Janssen); thermo-diffusive properties of cast-iron; the idea of unity in chemical and cosmic phenomena; the radiometer, &c. In the group of natural sciences:—Vichy waters, from a physiological and hygienic point of view; recent prehistoric discoveries in Medoc; animal heat; influence of the want of air and light in the streets and houses on health; functions of leaves and roots of plants in tropical countries; cure of paralysis by continuous currents; operations for cataract; the bite of vipers; ophthalmia in the North of Africa; proof of the existence of ferment-germs in the organism as in the air; a new æsthesiometer; production of phenomena of synthesis in plants; sporadic and endemic goître in Puy-de-Dôme; on measles in beef and inermous tænia; resources of France as regards war-horses; various points in local archæology, geology, palæontology, &c. In the group of economical sciences:—Teaching of living languages, from the economical point of view; remedies for phylloxera; depopulation of the country and emigration to America; workmen's dwellings and morality of France; economical consequences of the war indemnity, &c., &c.

THE storm of August 3 will be long remembered not only as being about the heaviest summer gale that has occurred for many years, but also as having been most disastrous to life and property among the fishing population. It broke out on the fishermen on the east coast just when their nets had been shot for the night at distances of twenty miles, and upwards, out at sea. The value of the nets lost at Aberdeen alone is estimated at 4,000*l*. The rate of the fall of the barometer being nearly an inch in twenty-four hours, the point to which it fell being about 29·0 inches at sea-level over a wide district in the north, the time during which it remained low, and the large and comparatively rapid rise which followed are rather the characteristics of our more marked winter storms. A storm of this nature is, therefore, deserving of a very careful investigation, chiefly with the view of ascertaining how far it might have been possible to have given the fishermen some intimation beforehand of its peculiarly destructive character.

IN the *Bulletin International* of August 3, M. de Tastes relates some interesting particulars of a waterspout (*trombe*) which was observed near Tours, on May 25, 1876. It first appeared as a mass of whitish vapour against a background of

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dark-coloured clouds, which gradually assumed the form of an inverted cone pointing to the ground, and terminating in a long sinuous band. A whitish sinuous column soon appeared suddenly between it and the ground, and rapidly enlarged upwards, the whole phenomenon soon assuming the appearance of two cones united at their summits. The lower cone, at first lightish-coloured and in a certain degree transparent, gradually assumed a darker shade, which was propagated from the base towards the summit. When passing over the right bank of the Loire, a dense mass of sand, mud, and fine gravel, was observed drawn towards it; in crossing the river a *jet d'eau* broken into spray appeared in the form of a cone ascending the waterspout, with its base resting on the water, the spray on all sides being drawn inwards towards the axis in spires. It is said that an undefined glimmering appearance preceded the column of ascending spray. On reaching the extensive sandy shore of the left bank, clouds of sand were drawn violently in upon it, just as happened with the spray of the river. From the value of several of these points in the theory of waterspouts and other aërial movements, it is desirable, as opportunity offers that they be tested by observations made with the greatest accuracy and skill.

MR. F. E. NIPHER writes to the *American Journal of Science and Arts*, that not long since, while writing logarithms that were being read to him, he observed that the probability of error in writing the numbers appeared to be much less at the extremities of the number than in the middle. This he investigated at length in numbers of from five to ten digits. It was found that the probability of error is in all cases expressed by the terms of the expanded binomial $(a + b)^n$, where n is a function of the number of digits. a and b were, so far, always unequal with all the persons that had been experimented on. The probability of error is greatest just after the middle of the number. This led to an interesting investigation on the power of memory. Allowing definite intervals (t) of time to elapse between the giving and the writing of the number, it is evident that the number of errors will increase with the value of t. In order to aid the experimenter in abstaining from mentally repeating the number which he is to write, he is allowed to determine the value of t by counting the beats of a seconds pendulum. The investigation is yet in progress, but enough has been done to develop the fact that the relation between the number of figures (per 100) written correctly, and the values t, is a logarithmic one. It is the same as the function expressing the decrease in the amplitude of the beats of a pendulum in time, as due to a resisting medium.

WE learn from the same journal that the trustees of the Massachusetts Society for promoting Agriculture have offered some very handsome prizes for special plantations within the State of Massachusetts. In the first place, for the best plantation of not less than five acres of larch, or on the Cape, &c., of Scotch or Corsican pine, originally of not less than 2,700 trees to the acre, on poor, worn-out, or otherwise agriculturally worthless land, a prize of $1,000. For the next best, a prize of $600; for the third best, $400. Next, for the best plantation of the same extent with American white ash, not less than 5,000 trees to the acre, a prize of $600; for the next best, $400. Intending competitors must notify the Secretary of the Society, E. W. Perkins, Jamaica Plain, Boston, as early as December 1, 1876, and plant in the spring of 1877. Special directions, not only for planting and caring for, but also for procuring trees for the purpose, are given in a recently-published pamphlet by Prof. Sargent, of Harvard, "A Few Suggestions on Tree-planting," which the Society has reprinted for gratuitous distribution; and a citizen of Boston patriotically offers to look after the importation of the seedling trees, which, in such quantities, and for next year's planting, would have to be obtained mainly in Europe, at least the pines and larches. The ashes, probably, would have to be raised from seed; and the time, if need be, would doubtless be extended. The prizes are to be awarded in the summer of 1877.

AMONG various experiments with the radiometer which have lately been described to the French Academy, is one in which M. Govi inclosed a very sensitive instrument (the vanes of which were of polished aluminium on the one side and blackened mica on the other) in a glass cylinder, into which was continuously passed steam from boiling water. The radiometer began quickly to rotate (the aluminium face first) immediately the steam commenced to raise the temperature of the inclosure. Ere long, however, the temperature becoming invariable, the rotation diminished, and after a few minutes ceased altogether. On stopping the entrance of steam, the instrument rotated anew, but in the opposite direction, and did so for a long time before stopping. Every motionless radiometer, M. Govi points out, is like the instrument stopped at 100° in the above experiment. To make it turn in the inverse direction, you have merely to put it in a vessel of cold water; the black faces then move first, and the instrument only stops after a new state of thermal equilibrium has been established On being brought out of the cold water it turns as though it were struck by light, although it may be in complete darkness. A radiometer motionless in the inclosure at 100°, or at zero, will turn anew if the light of a bright flame be directed on the blackened face of its vanes; "because in both cases the light absorbed by the blackened face then becomes heat, which is added to that which the vanes possess already, and may consequently further liberate gas from them." In an experiment described by M. Ducretet, ether is poured on the envelope of a radiometer which moves with *direct* rotation (black surfaces repelled) in moderate daylight. The motion is arrested and changed to that in the *inverse* direction. This reaction presently ceases, and the vanes resume the original *direct* motion, notwithstanding the evaporation maintained on the envelope by a light sprinkling of ether. The rotation now becomes more rapid than it was at first, the evaporation apparently acting as a source of heat, and yet the lowering of temperature through evaporation is very perceptible. When the sprinkling with ether ceases, the motion resumes its normal velocity and remains *direct*. M. Ducretet also tried the effect of phosphorescent powders on the radiometer, but got no motion.

THE number of visitors to the Loan Collection of Scientific Apparatus during the week ending August 5 was as follows:—Monday, 2,951; Tuesday, 3,377; Wednesday, 488; Thursday, 441; Friday, 441; Saturday, 3,422; total, 11,120.

AN interesting contribution to the study of the eye affection known as neuro-paralytic keratitis, by Dr. Decker, has just appeared in the *Archives des Sciences*. He arrives at the following conclusions:—(1) It is not an ordinary traumatic keratitis. (2) It results from the combined action of two orders of things, *a*. determining causes, which are the exterior modifying agents; *b*. a predisposing cause, consisting in diminution of the resistance of the eye, the most exposed parts of which (cornea), become easily altered by the determining causes. (3) This vulnerability is the result of lesion of nerve fibres in the internal side of the trigeminus. 4. These are neither sensitive nor vasomotor nerves. 5. The hypothesis that they are trophic nerves best accounts for the facts observed. 6. Anatomically, neuroparalytic keratitis consists of a primary necrosis of the central part of the cornea (if the latter be left open), followed in a short time by a secondary inflammation of the peripheric parts, and of the conjunctiva.

MM. BECQUEREL give a brief notice in the *Bulletin Hebdomadaire*, No. 456, of the Scientific Association of France, of the observations of temperature made at the Museum of

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Natural History, during 1875, with electric thermometers placed in the air, and in soils covered with grass and soils cleared of vegetation. From the results of the last four years, it is shown that the mean annual temperature of the two soils, at a depth of 39 inches, and that of the air, is nearly alike; that at depths of from 4 to 24 inches the influence of vegetation is to raise the annual mean 0°·7 above that of soils clear of vegetation; and that during these four years the temperature of soils covered with grass or any other vegetation has not fallen to freezing (32°), a fact of no little importance to horticulture.

EXPERIMENTS were made at Paris recently, before M. Baron, Director of the Electric Telegraph, on a new system for dividing the electric light. A single generator has fed with an admirable regularity not less than eighteen lamps, having each a power equal to 100 gas-jets. The effect was wonderful, and the apparatus will be tried shortly at the Lyons railway terminus. The principle is very simple, and was discovered by a working shoemaker. The current derived from a Gramme machine, slightly modified, is sent to a second machine, which rotates before forty-eight electro-magnets, four of these electro-magnets having a force sufficient to give a light equivalent to 100 gas-jets. Twelve electric lamps can be fed at any distance. By a very simple commutator any number of these twelve lamps can be grouped together, so that one, two, or more can be set in the same apparatus. Twelve working on the same point give a real burning sun. The force required for working both machines (the prime mover and the distributor) is derived from a 4 horse-power steam-engine. The experiments at the Lyons railway will be tried with sixteen lamps and an engine of from 6 to 7 horse-power. The light will be equal to 1,600 gas-jets.

THE French Society of Agriculture and Insectology will, as usual, hold its bi-annual exhibition at the Orangerie des Tuileries in September. The exhibition being universal, some contributions are expected from England. The last having been a success, left a large surplus in the hands of the Society, which will enlarge the scale of its operations.

SOME details regarding the malacological fauna of the Island of Saint Paul have been furnished by M. Velain, in a note to the French Academy, and will doubtless interest zoologists. Little was previously known of this fauna. The island, it is known, is more than 500 leagues distant from any continents, and the tranquil lake in the old crater of the volcano seemed likely to favour the development of embryos brought by oceanic currents. The list of Gasteropoda and Lamellibranchia comprises forty species, distributed in twenty-nine genera, five of which are new. This fauna, notwithstanding the small latitude of the island, is remarkable for its austral forms. The species are mostly of small size, rarely exceeding 3 mm.; among them appear as a giant the Ranella described by Frauenfeld, which sometimes reaches 8 cm. in height. The island may be said to have two distinct fauna, that of the interior of the crater and that of the exterior; the latter is less rich; the abrupt sides, environed with reefs on which the sea incessantly breaks with violence, being hardly favourable to the thriving of marine molluscs. The species here have short, rounded forms, with thick shells. Within the crater the littoral zone is extraordinarily rich in individuals, though not in species. The conditions are: a rocky bottom exposed to the light, weak pressure, temperature kept nearly constant by thermal springs (13° to 14° C.), agitation almost *nil*, marine vegetation extremely abundant. As for deep fauna, there is none of it; the abundant liberation of carbonic acid gas at the bottom of the crater prevents life being manifested below 20 to 25 metres. The deep fauna of the exterior, on the other hand, is very rich, as indicated by the shells thrown up on the beach. The fauna of Amsterdam Island is identical with that of the exterior of Saint Paul, only the proportion of the different species varies. There is, however, a gasteropod of the genus *Helix*, which is peculiar to the island.

IT was proved, a short time ago, that several kinds of seeds will germinate between pieces of ice. A full investigation of the lower limit of temperature at which plants may germinate has recently been made by M. Haberlandt (*Centralblatt für Agricultur chemie*). The experiments were upon wheat, rye, barley, red beet, rape, lucerne, poppy, and many other seeds. Several hundred seeds were employed of each species, and every fourteen days the seeds were taken out of the ice-chest, whose temperature was kept constant between 0° and 1°, and examined in a space whose temperature was under freezing-point. In forty-five days a decided beginning of germination was observable in eight different species (which are named). In four months it had continued to progress in a minority of these; the rest had stopped. In fourteen species there was no germination. M. Haberlandt is of opinion that those seeds which can germinate at a lower temperature than others of the same species, will give plants that require a less amount of heat for their complete development than the others, and thus by artificial sowing in cold spaces a means is to hand of obtaining species soon ripe and needing little heat. Of all the seeds which had remained for four months in the ice-case, only a few were found capable of development when brought into a warmer temperature of 16° C.

A UNIVERSAL CONGRESS for hygienic purposes and salvage will be held at Brussels on the occasion of the Exhibition. The Congress will meet from Sept. 27 to Oct. 4. A French committee has been formed of M. Claude Bernard, Admiral Paris, and others. A programme of the questions that are to come before the meeting will be found in the *Sanitary Record* for August 5.

THE *Meteorologische Beobachtungen* made at the hydrographic office of the Austrian navy at Pola during June last have been received. They are interesting from the position of Pola being near the southern extremity of the peninsula at the head of the Adriatic. The hourly observations show a strongly-pronounced maximum of wind force from 11 A.M. to 6 P.M., when it is nearly double the force registered from 9 P.M. to 6 A.M. The daily variation in the direction of the wind is equally well marked. Starting from a point east of south at 5 A.M., it gradually veers to westward, the most westerly point (nearly due west) being reached at 5—6 P.M., after which it gradually shifts back to its starting-point in the morning. The most interesting point in the diurnal curve of the barometer is the occurrence of the morning maximum at noon, being the time when this phase of the pressure occurs at places situated close to the sea-shore. The maximum temperature occurs as early as from noon to 1 P.M.

MRS. GRIESBACH has presented to the Lord President of the Council, for the proposed scientific museum, a valuable collection of acoustical apparatus, invented and made by her late husband, John Henry Griesbach. This apparatus is now exhibited in the Loan Collection of Scientific Apparatus.

IN a supplement to the *Gardener's Chronicle* for Aug. 5, is given a well-illustrated description of the Royal Botanic Gardens at Kew, including views in the centre of the palm-stove, the succulent house, the temperate house, &c.

THE additions to the Zoological Society's Gardens during the past week include a Racoon-like Dog (*Nyctercutes procyonides*) from Eastern Asia, presented by Capt. W. H. Bingoym; seven Common Guillemots (*Uria troïle*) and a Kittiwake Gull (*Rissa tridactyla*), British, presented by Sir H. Dalrymple, Bart.; a Brown Coati (*Nasua nasica*) from South America, presented by Mr. R. C. Corfield; two Hairy Armadillos (*Dasypus villosus*), born in the Gardens.

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